

**What Is Claimed Is:**

- 1        1. An integrated circuit comprising:
  - 2            an output buffer receiving a first value followed by a second value, wherein said first
  - 3            value is not equal to said second value; and
  - 4            a control block changing a strength of said output buffer gradually while said output
  - 5            buffer provides said second value as a buffer output.
- 1        2. The integrated circuit of claim 1, wherein said output buffer comprises a drive
- 2            transistor, and wherein said control block comprises:
  - 3            a capacitor provided at a gate terminal of said drive transistor; and
  - 4            a current source for altering the total charge on said capacitor slowly to change said
  - 5            strength gradually.
- 1        3. The integrated circuit of claim 2, wherein said capacitor comprises a gate
- 2            capacitance of said drive transistor.
- 1        4. The integrated circuit of claim 2, wherein said output buffer comprises a plurality
- 2            of inverters, wherein one of said plurality of inverters comprises said drive transistor.
- 1        5. The integrated circuit of claim 4, wherein said drive transistor is contained in a last
- 2            one of said plurality of inverters.
- 1        6. The integrated circuit of claim 2, wherein said drive transistor comprises a PMOS

2 transistor, wherein said current source discharges said capacitor to control said drive strength  
3 when said second value is greater than said first value.

1           7. The integrated circuit of claim 6, wherein said control block comprises:  
2           a voltage adjusting block which determines a total strength to be applied to said drive  
3 transistor when said second value is greater than said first value, and provides a PCTRL  
4 signal representing said total strength; and

5           a slew controller block coupled to said drive transistor, said slew controller block  
6 containing said current source, wherein said current source receives said PCTRL to determine  
7 the amount of current to supply to discharge said capacitor.

1           8. The integrated circuit of claim 7, wherein said control block comprises:  
2           a delay module delaying a clock signal to generate a delayed clock signal, wherein  
3 said clock signal is used to control the timing of reception of said first value and said second  
4 value; and

5           a comparator comparing said buffer output with a threshold voltage to determine  
6 whether said buffer output is rising at a desired rate, said comparator providing a comparison  
7 result,

8           wherein said voltage adjusting block adjusts said total strength according to said  
9 comparison result.

1           9. The integrated circuit of claim 8, wherein said voltage adjusting block adjusts said  
2 total strength in multiple increments until said total strength equals a desired strength,

3 wherein said desired strength is determined by said desired rate.

1 10. The integrated circuit of claim 7, wherein said current source comprises:

2 a first transmission gate which conducts in one logical state of a clock signal and does  
3 not conduct on the other logical state of said clock signal, said first transmission gate being  
4 connected between a first node and a second node, said second node being coupled to a  
5 supply voltage;

6 a second transmission gate being connected between said first node and a third node,  
7 said second transmission gate conducting in said other logical state of said clock signal and  
8 not conducting in said one logical state of said clock signal, said third node being coupled  
9 to receive said PCTRL; and

10 a second capacitor coupled between said first node and said voltage supply, wherein  
11 a desired amount of current to discharge said capacitor is generated at said third node.

1 11. The integrated circuit of claim 10, wherein the capacitance of said second  
2 capacitor equals the capacitance of said capacitor.

1 12. The integrated circuit of claim 11, wherein said current source further comprises  
2 a drop transistor connected between said supply voltage and said second node, said drop  
3 transistor providing a voltage drop to apply a voltage of said supply voltage less said voltage  
4 drop at said second node so as to switch off said drive transistor.

1 13. The integrated circuit of claim 12, further comprising:

2           a second drop transistor provided between said supply voltage and a gate terminal of  
3        said PMOS transistor, wherein said second drop transistor also provides said voltage drop to  
4        apply a voltage of said supply voltage less said voltage drop at said gate terminal of said  
5        PMOS transistor.

1           14. The integrated circuit of claim 13, further comprising a clamping circuit to clamp  
2        the voltage at the gate terminal of said PMOS transistor to said PCTRL.

1           15. The integrated circuit of claim 2, wherein said drive transistor comprises a NMOS  
2        transistor, wherein said current source charges said capacitor to control said drive strength  
3        when said second value is less than said first value.

1           16. The integrated circuit of claim 6, wherein said control block comprises:  
2           a voltage adjusting block which determines a total strength to be applied to said drive  
3        transistor when said second value is less than said first value, and provides a NCTRL signal  
4        representing said total strength; and

5           a slew controller block coupled to said drive transistor, said slew controller block  
6        containing said current source, wherein said current source receives said NCTRL to  
7        determine the amount of current to supply to discharge said capacitor.

1           17. The integrated circuit of claim 16, wherein said control block comprises:  
2           a delay module delaying a clock signal to generate a delayed clock signal, wherein  
3        said clock signal is used to control the timing of reception of said first value and said second

4 value; and

5 a comparator comparing said buffer output with a threshold voltage to determine  
6 whether said buffer output is falling at a desired rate, said comparator providing a  
7 comparison result,

8 wherein said voltage adjusting block adjusts said total strength according to said  
9 comparison result.

1 18. The integrated circuit of claim 13, further comprising a clamping circuit to clamp  
2 the voltage at the gate terminal of said NMOS transistor to said NCTRL.

1 19. The integrated circuit of claim 1, wherein said strength is changed such that an  
2 output signal of said output buffer changes from a first voltage level representing said first  
3 value to a second voltage level representing said second value in a duration which is  
4 substantially more than 15% of a clock cycle duration using which said first value and said  
5 second value are received.

1 20. The integrated circuit of claim 1, wherein said duration equals at least 40% of said  
2 clock cycle duration.

1 21. A device comprising:

2 an output buffer receiving a first value followed by a second value, wherein said first  
3 value is not equal to said second value; and  
4 a control block changing a strength of said output buffer gradually while said output

5 buffer provides said second value as a buffer output.

1           22. The device of claim 21, wherein said output buffer comprises a drive transistor,  
2 and wherein said control block comprises:

3           a capacitor provided at a gate terminal of said drive transistor; and  
4           a current source for altering the total charge on said capacitor slowly to change said  
5 strength gradually.

1           23. The device of claim 22, wherein said capacitor comprises a gate capacitance of  
2 said drive transistor.

1           24. The device of claim 22, wherein said output buffer comprises a plurality of  
2 inverters, wherein one of said plurality of inverters comprises said drive transistor.

1           25. The device of claim 24, wherein said drive transistor is contained in a last one of  
2 said plurality of inverters.

1           26. The device of claim 22, wherein said drive transistor comprises a PMOS  
2 transistor, wherein said current source discharges said capacitor to control said drive strength  
3 when said second value is greater than said first value.

1           27. The device of claim 26, wherein said control block comprises:  
2           a voltage adjusting block which determines a total strength to be applied to said drive

3 transistor when said second value is greater than said first value, and provides a PCTRL  
4 signal representing said total strength; and

5 a slew controller block coupled to said drive transistor, said slew controller block  
6 containing said current source, wherein said current source receives said PCTRL to determine  
7 the amount of current to supply to discharge said capacitor.

1 28. The device of claim 27, wherein said control block comprises:

2 a delay module delaying a clock signal to generate a delayed clock signal, wherein  
3 said clock signal is used to control the timing of reception of said first value and said second  
4 value; and

5 a comparator comparing said buffer output with a threshold voltage to determine  
6 whether said buffer output is rising at a desired rate, said comparator providing a comparison  
7 result,

8 wherein said voltage adjusting block adjusts said total strength according to said  
9 comparison result.

1 29. The device of claim 28, wherein said voltage adjusting block adjusts said total  
2 strength in multiple increments until said total strength equals a desired strength, wherein  
3 said desired strength is determined by said desired rate.

1 30. The device of claim 27, wherein said current source comprises:

2 a first transmission gate which conducts in one logical state of a clock signal and does  
3 not conduct on the other logical state of said clock signal, said first transmission gate being

4 connected between a first node and a second node, said second node being coupled to a  
5 supply voltage;

6 a second transmission gate being connected between said first node and a third node,  
7 said second transmission gate conducting in said other logical state of said clock signal and  
8 not conducting in said one logical state of said clock signal, said third node being coupled  
9 to receive said PCTRL; and

10 a second capacitor coupled between said first node and said voltage supply, wherein  
11 a desired amount of current to discharge said capacitor is generated at said third node.

1 31. The device of claim 30, wherein the capacitance of said second capacitor equals  
2 the capacitance of said capacitor.

1 32. The device of claim 31, wherein said current source further comprises a drop  
2 transistor connected between said supply voltage and said second node, said drop transistor  
3 providing a voltage drop to apply a voltage of said supply voltage less said voltage drop at  
4 said second node.

1 33. The device of claim 32, further comprising:  
2 a second drop transistor provided between said supply voltage and a gate terminal of  
3 said PMOS transistor, wherein said second drop transistor also provides said voltage drop to  
4 apply a voltage of said supply voltage less said voltage drop at said gate terminal of said  
5 PMOS transistor.

1           34. The device of claim 33, further comprising a clamping circuit to clamp the  
2           voltage at the gate terminal of said PMOS transistor to said PCTRL.

1           35. The device of claim 22, wherein said drive transistor comprises a NMOS  
2           transistor, wherein said current source charges said capacitor to control said drive strength  
3           when said second value is less than said first value.

1           36. The device of claim 26, wherein said control block comprises:  
2           a voltage adjusting block which determines a total strength to be applied to said drive  
3           transistor when said second value is less than said first value, and provides a NCTRL signal  
4           representing said total strength; and  
5           a slew controller block coupled to said drive transistor, said slew controller block  
6           containing said current source, wherein said current source receives said NCTRL to  
7           determine the amount of current to supply to discharge said capacitor.

1           37. The device of claim 36, wherein said control block comprises:  
2           a delay module delaying a clock signal to generate a delayed clock signal, wherein  
3           said clock signal is used to control the timing of reception of said first value and said second  
4           value; and  
5           a comparator comparing said buffer output with a threshold voltage to determine  
6           whether said buffer output is falling at a desired rate, said comparator providing a  
7           comparison result,  
8           wherein said voltage adjusting block adjusts said total strength according to said

9 comparison result.

1       38. The device of claim 33, further comprising a clamping circuit to clamp the  
2 voltage at the gate terminal of said NMOS transistor to said NCTRL.

1       39. The device of claim 21, wherein said strength is changed such that an output  
2 signal of said output buffer changes from a first voltage level representing said first value to  
3 a second voltage level representing said second value in a duration which is substantially  
4 more than 15% of a clock cycle duration using which said first value and said second value  
5 are received.

1       40. The device of claim 21, wherein said duration equals at least 40% of said clock  
2 cycle duration.

1       41. The device of claim 21, wherein said device further comprises a load receiving  
2 said buffer output.

1       42. The device of claim 41, wherein said load comprises a transmission line.

1       43. The device of claim 21, wherein said device comprises a wireless base station,  
2 said device further comprising:  
3           an antenna receiving an external signal; and  
4           an analog processor processing said external signal to generate said first value and

5 said second value.

1           44. An apparatus comprising:

2           an output buffer receiving a transition from a first value to a second value, wherein  
3           said first value is not equal to said second value, said buffer providing said first value  
4           followed by said second value on a buffer output; and

5           means for changing a strength of said output buffer gradually while providing said  
6           second value on said buffer output.

1           45. The apparatus of claim 44, wherein said output buffer comprises an inverter  
2           containing a transistor, wherein said means for changing alters slowly an amount of charge  
3           on a capacitor provided at a gate terminal of said transistor.

1           46. The apparatus of claim 45, wherein said capacitor comprises a gate capacitance  
2           of said gate terminal.

1           47. The apparatus of claim 45, wherein said means for changing comprises a current  
2           source to perform said altering.

1           48. A method of processing a transition from a first value to a second value, wherein  
2           said first value is not equal to said second value, said method comprising:  
3           receiving said first value followed by said second value on a buffer input of an output  
4           buffer;

5           providing said first value on a buffer output of said output buffer; and  
6           changing a strength of said output buffer gradually while providing said second value  
7       on said buffer output.

1           49. The method of claim 48, wherein said output buffer comprises an inverter  
2       containing a transistor, said changing comprises altering slowly an amount of charge on a  
3       capacitor provided at a gate terminal of said transistor.

1           50. The method of claim 49, wherein said capacitor comprises a gate capacitance of  
2       said gate terminal.

1           51. The method of claim 49, wherein said changing is performed using a current  
2       source.

1           52. The method of claim 51, wherein said strength is changed such that an output  
2       signal of said output buffer changes from a first voltage level representing said first value to  
3       a second voltage level representing said second value in a duration which is substantially  
4       more than 15% of a clock cycle duration using which said first value and said second value  
5       are received.

1           53. The method of claim 52, wherein said duration equals at least 40% of said clock  
2       cycle duration.